



Distributed Utility Integration Test

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Distributed Utility Associates

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Project Description

- ✍ Design a test regimen to help understand the integration and interaction of multiple and diverse DER's in a utility distribution system
- ✍ Determine requirements for testing of distributed resources to support the development and implementation of the Distributed Power Program
- ✍ Determine site requirements
- ✍ Coordinate stakeholders site, testing and DER requirements
- ✍ Develop a detailed plan and site description/requirements for conducting integration testing



Distributed Utility Integration Test Partners

DUA
Endecon Engineering
PG&E
Exelon (PECO)
California Energy
Commission
Salt River Project
Texas PUC

Encorp
Caterpillar
Solar Turbines
Onsite Energy
SMUD
Niagara Mohawk

Distributed Utility Integration Test Tasks and Objectives

- ✍ Build a team
- ✍ Document appropriate technologies
- ✍ Review operating test sites and document features of appropriate site(s)
- ✍ Develop a project plan that would support the testing needs of the DOE Distributed Power Program

Task 1: DUIT Stakeholder Outreach and Consensus Building

- ✍ **Distributed Utilities Associates and core project team, will determine role of the host utility**
- ✍ **Seek cofunding and support from other research and development organizations**
- ✍ **Select candidate technologies**

Deliverable: Develop Integration Test Concept Paper include consensus objectives, goals and stakeholder perspectives

Task 2: Technology Evaluation, Selection and Availability

Rotating DR

- Synchronous MG-sets
- Induction Generator Systems

Inverter Based DR

- Fuel Cell
- Photovoltaic
- Microturbine

Storage Technologies

- Flywheel
- SMES
- Batteries

Deliverable: Technology Selection Report

Inverter Supplier Table (Partial)

Supplier	Electrical Rating	Physical Size	Weight	Venting Requirements	Fuel Requirements	Indoor/Outdoor Rating	Ambient Temperature
Advanced Energy Systems Aerovironment	1KVA	19"Hx8"Wx6.5"D	43 Lbs.	None	None	Full outdoor	-40Deg. C 60Deg.C
Xantrex/Trace Eng. Model ST	1 - 2.5	33.5"Hx13.25"Wx5.3"D	35 Lbs.	None	None	Indoor, outdoor with optional rain shield	-39Deg. C 45Deg. C
Xantrex/Trace Tech. Model PV 10	10KVA	26"Hx18"Wx10"D	75 Lbs.	None	None	NEMA 4 outdoor rating	-20Deg.C 50Deg.C
Xantrex/Trace Tech Model PV 15, 20	15 – 20 KVA	30"Hx25"Wx13"D	175 Lbs.	None	None	NEMA 4 outdoor rating	-20Deg. C 50Deg. C
S&C Omnion Model 2400	2.2 – 6 KVA	28"Hx18"Wx8"D	74 Lbs.	None	None	NEMA 3R outdoor rating	-20Deg. C 40 Deg.C (45 for some products)
S&C Omnion Model 2500	1- 2 KVA	21.75"Hx12"Wx7.25"D	1KVA – 35 Lbs. 2KVA – 40 Lbs.	None	None	NEMA 3R IP 32	-25 Deg. C 50 Deg. C
S&C Omnion	50 – 100KVA	75"Hx76"Wx38"D	50KVA – 2000 Lbs. 100KVA – 2200Lbs.	None	None	NEMA 3R	-30 Deg. C 50 Deg.C
Vanner Model RE24-4500DGT	4.5KVA	29"Hx20.5"Wx9.25"D	95 Lbs.	None	None	N.A.	4.5KVA@ 25Deg.C

Task 3: DUIT Site Assessment

- ✍ **Evaluate potential test locations**
 - **recommend site (or combination of sites) for operation and testing of distributed generation technologies by the DUIT project**
- ✍ **Includes an assessment for each site**

Sites Evaluated

Detailed facility information was obtained from the following locations for evaluation as DUIT testing sites:

- ✍ Dolan Test Center – Groveport, OH
- ✍ Modular Generation Test Facility (MGTF) – San Ramon, CA
- ✍ National Renewable Energy Laboratories (NREL) – Golden, CO
- ✍ Oak Ridge National Laboratory – Oak Ridge, TN
- ✍ Pacific Northwest National Laboratories (PNNL) – Hanford, WA
- ✍ Power Electronics Applications Center (PEAC) – Knoxville, TN
- ✍ Sandia National Laboratories – Albuquerque, NM
- ✍ Solar Test and Research (STAR) Facility – Phoenix, AZ
- ✍ Southwest Research Institute (SWRI) – San Antonio, TX
- ✍ University of California at Irvine – Irvine, CA
- ✍ University of Wisconsin – Madison, WI

Site Assessment Criteria






- ✍ Available space – number of test cells or bays, their sizes, and limitations
- ✍ MW Rating – largest single DR allowable; total allowed DG for facility
- ✍ Existing/permanent DRs on-site – potential for reducing acquisition costs of new equipment
- ✍ Existing testing equipment – controls, monitoring and instrumentation, switching load banks, etc.
- ✍ Host utility's level of interest, support and involvement, both financial and in terms of personnel time and expertise
- ✍ Ability to test in both radial and network circuit configurations
- ✍ Grid supply – voltage, MVA, switching arrangements, and limitations
- ✍ Fuel supply and storage – natural gas line size, pressure and flow rate (BTU/hr); diesel, hydrogen, gasoline, LPG availability and/or storage capability

Site Assessment Criteria

- ✍ Flexibility of facility to evolve or adapt to future/unforeseen testing needs
- ✍ Limitations – noise, emissions, other
- ✍ Ability to test multiple DRs at once, in interactive modes
- ✍ Number and expertise of testing staff
- ✍ Testing history/experience relevant to DUIT
- ✍ Costs - for required facility upgrades to accommodate DUIT testing, as well as for the testing itself. Factors to consider:
 - cost of DR technologies (purchase, rental, lease, O&M, fuel, etc.)
 - number of DR installations and removals
 - duration of tests
 - fuel costs
 - analysis and reporting requirements
 - requirements of host utility (meetings, trips, etc.)
 - special installation equipment required
 - control equipment for multiple DRs

Task 4: DUIT Project Plan

DUIT Plan:

-  **Technology**
-  **Site specification**
-  **Test plan**
-  **DAS requirements**
-  **Costs and schedule**


Test Plan: Issues for All Tests

- ✍ **High vs Low DR penetration levels**
- ✍ **Legacy vs future distribution systems**
- ✍ **DR as a nuisance vs DR as a resource**
- ✍ **Export vs non-export**
- ✍ **Interaction between different distributed resources**
- ✍ **Distributed resource types**
 - Rotating: synchronous and induction
 - Inverter-based
- ✍ **Control aggregation**
- ✍ **Scalability**
- ✍ **Single vs 3 phase**
 - DR, faults and other events
- ✍ **Abnormal conditions**

Test Plan Development

- ✍ Reviewed numerous documents related to DR:
 - IEEE P1547, IEEE 929, UL 1741
 - EEI DR Task Force Interconnection Study (29 Issues)
 - California, New York, Texas, and other existing interconnection rules
- ✍ Discussed issues within the DUIT team and with many other utility engineers and equipment providers
- ✍ Developed a series of test protocols

Major Test Plan Categories

-  Test Protocols address:
- Anti Islanding
 - Voltage Regulation
 - Sectionalizing Devices
 - Reclosing
 - Synchronization
 - Short Circuit Current
 - Stability
 - Fuse Coordination

Test Protocols - Review

- ✍ Test Protocol document was sent to key utilities, manufacturers and other stakeholders for review. Asked reviewers to:
 - Provide feedback on content
 - Identify missing tests or issues
 - Prioritize tests
- ✍ 15 divers respondents
- ✍ Received minimal ideas for test variations
- ✍ Prioritization was inconsistent
 - Two issues seem to be of universal concern:
 - Islanding
 - Voltage Regulation

DUIT Summary

- ✍ Completed technology evaluation
- ✍ Completed review of facilities that could be considered for conducting testing
- ✍ Designed and Peer reviewed testing protocols that could be implemented at a DUIT site
- ✍ DUIT draft final Test Plan completed. This work supports DOE DPP testing goals.